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Review of the DP AI SL/HL revision book (v24)

This review evaluates the **Diploma Programme Mathematics – Applications & Interpretation (SL & HL) Revision Book** (DPAISLHLv24) by checking its LaTeX source, reading the generated PDF and cross-checking against the official syllabus. The goal is to suggest improvements in content, layout and pedagogy for a second edition. Citations from official IB resources are used to support claims where possible.

Overall impressions

The revision book is comprehensive and well organised. Questions are grouped by topic and sub-topic in the same order as the IB Applications & Interpretation (AI) syllabus. Each question has its own answer space, a **"Final answer"** line and a hyperlink to the solution; the solutions section mirrors the order of the questions and contains detailed worked answers. A page border, header space for **Name** and **Date**, and a footnote encouraging feedback give the document a professional appearance. The use of hyperlinks for "Go to Solution" and "Back to TOC" is a nice feature for digital users. The book covers SL and HL material from Topics 1–5. The IB syllabus indeed expects AI HL students to handle eigenvalues/diagonalisation of 2×2 matrices [1] [2], matrix transformations and vector equations [2], HL modelling functions [3], and slope fields/Euler's method/phase-portraits for first- and second-order differential equations [4]. The revision book contains problems on these topics, showing awareness of the HL syllabus.

Nevertheless, some areas can be improved. The suggestions below are grouped by **content**, **layout/ organisation**, and **additional features**.

Content and pedagogy

1. **Provide explicit differentiation between SL and HL questions.**
   Currently the HL extensions are listed immediately after the corresponding SL sub-topic, but the questions themselves are not labelled "HL only." Less confident SL students may inadvertently attempt HL tasks (e.g., eigenvalue computations or Euler's method for second-order ODEs). Add a small "HL" tag next to HL-only questions or create separate HL sections so students can more easily identify the material relevant to their level.

2. **Align question difficulty with exam expectations.**
   The HL syllabus restricts diagonalisation to 2×2 matrices with distinct real eigenvalues [1]. Question AHL 1.15 (2) asks students to diagonalise $M = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$ and compute M^5 . This is appropriate, but the book could include one easier example (e.g. diagonalising a diagonal matrix) and explicitly remind students that complex eigenvalues or defective matrices are beyond the AI HL syllabus. Similarly, the question on the damped mass–spring system in AHL 5.18 asks to classify "overdamped, critically damped and underdamped," then derive the exact solution for the overdamped case. This goes beyond solving using Euler's method which is the focus of AHL 5.18 [4];

consider moving the analytic solution derivation to a challenge/exploration box and emphasising the numerical approach expected in the syllabus.

The solutions occasionally use algebraic techniques that may not be familiar to all HL students. For example, the solution to a second-order linear ODE uses the characteristic equation and the trace–determinant classification. Provide a brief summary of these methods or refer students back to the appropriate theory before applying them. Similarly, when solving systems of linear equations using matrices or eigenvectors, include a reminder of the matrix inverse formula and the definition of an eigenvector.

1. **Include more modelling and interpretation tasks.**
   The AI syllabus emphasises modelling and interpretation of results over purely symbolic manipulation. While the book includes some modelling problems (e.g., logistic growth, tide heights and real-world trigonometry), it lacks extended tasks that require students to collect or analyse data, interpret parameters or justify the suitability of a model. The statistics/probability section would benefit from data-based investigations—such as using technology to fit linear, exponential or logistic models and discuss residuals—or requiring students to explain the meaning of parameters in a regression equation.

In the calculus section, include more questions where students must interpret the meaning of a derivative or definite integral in context (e.g. interpreting slope as a rate of change, or explaining what the area represents). The syllabus emphasises the ability to describe behaviour using slope fields and phase portraits [4]; consider adding questions where students sketch qualitative solutions and interpret stability rather than only computing analytic solutions.

1. **Expand coverage of some HL sub-topics.**
2. *AHL 2.10 – Scaling large numbers and log–log plots.* The syllabus lists scaling and log–log graphs [3], but the revision book includes only SL 2.5 modelling with linear, exponential and sinusoidal functions. Add a short section with questions requiring students to interpret log–log plots (e.g., verifying power-law models) and to use logarithmic scales to linearise non-linear relationships. Include real-world examples, such as earthquake magnitude scales or population scaling laws.
3. *AHL 3.14–3.16 – Graph theory.* The syllabus includes HL topics on graph theory, adjacency matrices and algorithms for trees, cycles, the Chinese postman and travelling-salesman problems [5]. These appear to be absent from the book. Including a few problems on Euler and Hamiltonian circuits, drawing weighted graphs, interpreting adjacency matrices and applying algorithmic techniques would better prepare HL students for Paper 3.
4. *AHL 4.18 – t - and z -tests, type I/II errors.* The statistics section does contain t -test problems, but there is little on identifying type I and II errors and on choosing between one- and two-tailed tests. Add conceptual questions where students must state null and alternative hypotheses, decide on appropriate tail directions and interpret possible errors in context, especially for the HL content on inference [6].
5. *AHL 4.19 – Transition matrices and Markov chains.* There is no obvious section on Markov chains, yet this is a syllabus item [7]. Include a brief introduction with questions requiring students to construct transition matrices, find equilibrium distributions and interpret long-term behaviour in real contexts (e.g., market share or weather modelling).

6. *AHL 5.16–5.18 – Euler's method and phase portraits.* Questions on Euler's method for first-order equations and slope fields are present, but there is only one example of Euler's method for a

second-order system. Consider adding a task that explicitly asks students to convert a second-order ODE to a system of first-order equations, apply Euler's method and interpret the numerical solution. More practice with phase portraits (e.g., drawing trajectories for different initial conditions and discussing stability) would align with the syllabus emphasis [4] .

7. **Balance question counts across topics.**
   Topic 1 (Number & Algebra) contains many short calculation questions, whereas Topic 2 (Functions) and Topic 5 (Calculus) include long sets of routine derivatives and integrals. Meanwhile some sections such as probability distributions and vectors are comparatively short. Ensure each sub-topic has enough practice problems of varying difficulty. In the calculus chapter, reduce duplication of basic power-rule integrals and include more applications (area between curves, volumes of revolution and kinematics problems) to better reflect exam demands.

8. **Clarify instructions and notation.**

9. Indicate clearly whether angles are measured in degrees or radians. For example, in SL 3.4 the arc-length problem uses degrees; state this explicitly in the question. Similarly, when drawing graphs or computing trigonometric values, remind students if calculators should be set to radian mode.
10. For financial problems in Topic 1, consistently specify whether interest is compounded annually, monthly or continuously and define variables such as nominal rate, effective rate and real growth rate. Encourage students to use a financial calculator or built-in "TVM solver" where appropriate.
11. When asking for numerical answers, remind students of the IB convention of **three significant figures** unless otherwise stated. Some solutions round intermediate values to four or five decimals; emphasise correct rounding and units.

12. In statistics, define notation such as n , $\bar{x}$, s , σ , μ and clearly distinguish sample statistics from population parameters. Explain the rationale for pooling variances in two-sample t -tests before instructing students to use the calculator.

13. **Encourage use of technology with guidance.**
    Many questions instruct students to "use technology" but provide no guidance. Since the AI course requires familiarity with graphing calculators and computer algebra systems (CAS), include side-bars or worked examples showing keystrokes (e.g. setting up a regression, solving a system, plotting a function or performing a statistical test). Provide screenshots of typical calculator displays and warn about common pitfalls, such as choosing the wrong window for graphing or forgetting to check residual plots.

14. **Provide conceptual exercises alongside procedural ones.**
    Add short "Explain" or "Justify" prompts to encourage students to articulate reasoning. For instance, after computing the standard deviation of a data set, ask them to interpret whether the data are tightly clustered or widely spread. After finding eigenvalues, ask what the eigenvectors represent in a modelling context. Encouraging verbal explanations supports criterion C (communication and justification) on Paper 2 and Paper 3.

15. **Add reflective and TOK questions.**
    The syllabus highlights connections to theory of knowledge (TOK). Occasionally include questions that provoke reflection, such as "Why is the imaginary unit called *imaginary* and does the name affect

how students perceive its reality?" or "Discuss whether the assumptions behind the binomial distribution are realistic in a given context." Such prompts foster critical thinking and align with the IB philosophy.

16. **Check for minor typographical errors.**
A few symbols in the LaTeX source are inconsistent: e.g. missing braces in fractions or misaligned subscripts (such as using `x^{1/2}` vs. `\sqrt{x}`). Perform a thorough proof-read and compile the document to catch small errors. In diagrams, ensure scales are labelled and tick marks correspond to the numerical values used in the questions.

Layout and presentation

1. **Reduce the heavy border and optimise writing space.** The decorative box drawn on every page looks elegant, but it reduces the usable writing area and may distract students. Consider reducing the border thickness or using a simple footer line. This change would also save ink for printed copies.

2. **Increase answer space for multi-step problems.** Certain questions (e.g., solving systems by matrix inversion, performing logistic regression, Euler's method tables) require substantial working. The provided blank space and single "Final answer" line may be insufficient. Allocate more vertical space or insert continuation pages labelled "Working space." Alternatively, provide a separate answer booklet.

3. **Place the "Go to Solution" link consistently.** At present, the hyperlink sits on the same line as the question number, which may be overlooked. Moving it to the end of the question or setting it in a smaller italic font can reduce clutter. Similarly, add page-number references alongside the hyperlink to aid printed use (e.g., "[solution on p. 312]").

4. **Highlight definitions and formulas.** At the start of each sub-topic, include a boxed summary of key definitions, formulas and calculator commands. For example, preceding the financial-mathematics section with the compound-interest formulas or summarising the laws of logarithms before the relevant exercises. This supports students' recall and reduces the need to refer to external notes.

5. **Use colour and diagrams judiciously.** The current diagrams (especially in geometry, trigonometry and slope-field questions) are clear and helpful. However, some graphs could benefit from colour distinctions (e.g., drawing a function and its derivative in different colours) and from labelling intercepts or asymptotes directly on the graph. Ensure colour choices remain legible when printed in black & white.

6. **Consistent notation for vectors and matrices.** In Topic 3 the notation for vectors switches between boldface letters, arrow notation ($\overrightarrow{AB}$) and column matrices. Choose one style (e.g., boldface letters for vectors) and stick to it, but explain how it relates to other conventions. When presenting matrices, align brackets neatly and label rows/columns when appropriate. Define $\mathbf{i}, \mathbf{j}, \mathbf{k}$ clearly before using them.

7. **Improve accessibility.** Use clear fonts with adequate spacing and ensure that mathematical symbols (especially exponents and subscripts) are large enough to be read easily. Provide alt-text descriptions for diagrams in the digital version so that students using screen readers can follow the content.

8. **Interactive/online version.** Consider offering an electronic version where students can fill in answers directly on a tablet or computer. Hyperlinks could jump between questions and solutions, and interactive graphs could allow students to manipulate parameters (e.g., exploring how changing the ratio r affects convergence in an infinite geometric series).

Additional resources and support

1. **Formula booklet references.** The IB provides a formula booklet. Include margin notes pointing to the relevant formula-booklet page (e.g., "Formula booklet p. 15: sum of an arithmetic series") so students know which results they must memorise and which are provided in examinations.

2. **Worked examples before exercises.** Each sub-topic could begin with one or two fully worked examples illustrating typical exam questions. These examples can model the level of reasoning expected and highlight common pitfalls. Following the examples, include short check-your-understanding questions before moving on to standard exercise sets.

3. **Differentiated practice.** Provide questions labelled by difficulty (e.g., ★ for standard, ★★ for challenging, ★★★ for extension). This allows students to tailor their revision. For instance, AHL 5.17 questions on phase portraits could include an extension problem asking students to classify equilibrium points using the Jacobian matrix, while the standard problem simply asks them to sketch solution curves.

4. **Integration with past paper questions.** The book contains original questions, but linking them to IB past paper questions would help students understand the style and marking criteria. At the end of each sub-topic, provide a list of relevant past paper questions (with session and paper number) so students can practise under exam conditions. Additionally, summarise typical mark-scheme comments (e.g., "method marks awarded for correct set-up even if arithmetic is incorrect").

5. **Include mini-projects for IA preparation.** Since AI students must complete an internal assessment, consider adding open-ended mini-projects where students explore a topic in greater depth—such as modelling the spread of a virus using a logistic function or analysing traffic flow with Markov chains. Provide guidance on choosing data sources, structuring the investigation and reflecting on limitations.

Final remarks

The current revision book is a strong foundation for both SL and HL students. With clearer labelling of HL content, more modelling- and technology-focused tasks and improved layout, it can become an indispensable resource. Ensuring alignment with the full range of syllabus topics—including graph theory, transition matrices and advanced probability—and emphasising interpretation over rote calculation will better prepare students for their IB examinations and for further study in mathematics.

[1] IBDP Maths Applications and Interpretation: Syllabus, Study Notes
https://www.iitianacademy.com/ibdp-maths-applications-and-interpretation-syllabus-study-notes/

[2] [3] [4] [5] [6] [7] IB Questionbank
https://repo.pirateib.xyz/IB%20QUESTIONBANKS/5.%20Fifth%20Edition%20-%20TOPIC/questionbank.ibo.org/en/teachers/00000/questionbanks/51-dp-mathematics-applications-and-interpretation/syllabus_sections.html